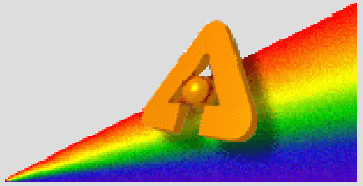


Access Control & Interlock System

ACIS – PSS Interfaces

Incorporating the

Front End Shutter Interface Enclosure (FESIE)

and the

Mezzanine PSS Test Chassis (MEZZIE)

Access Control & Interlock System

ACIS – PSS Front End Interfaces

- Signals exchanged
- ACIS logic
- Validation Requirements
- Existing problems and pitfalls
- Solutions
  - FESIE
  - MEZZIE
- Operation
- Schematics

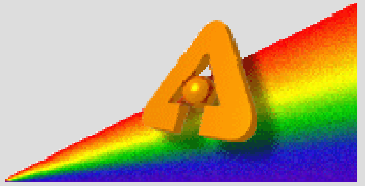
Access Control & Interlock System

ACIS – PSS Front End Interface

- Ultimately 70 interfaces, 35 sectors
- Four signals exchanged between the ACIS and PSS
  - ACIS to PSS
    - Closed position status of PS1, PS2, SS1, and SS2
    - Global Shutter Permit from the MCR
    - Global On/OFF Line Key Switch status
  - PSS to ACIS
    - Storage Ring Permit (PSS Trip)
- Isolated through relay contacts
- Asserted “ON” in safe and/or active state

Access Control & Interlock System

ACIS – PSS Front End Interface Configuration

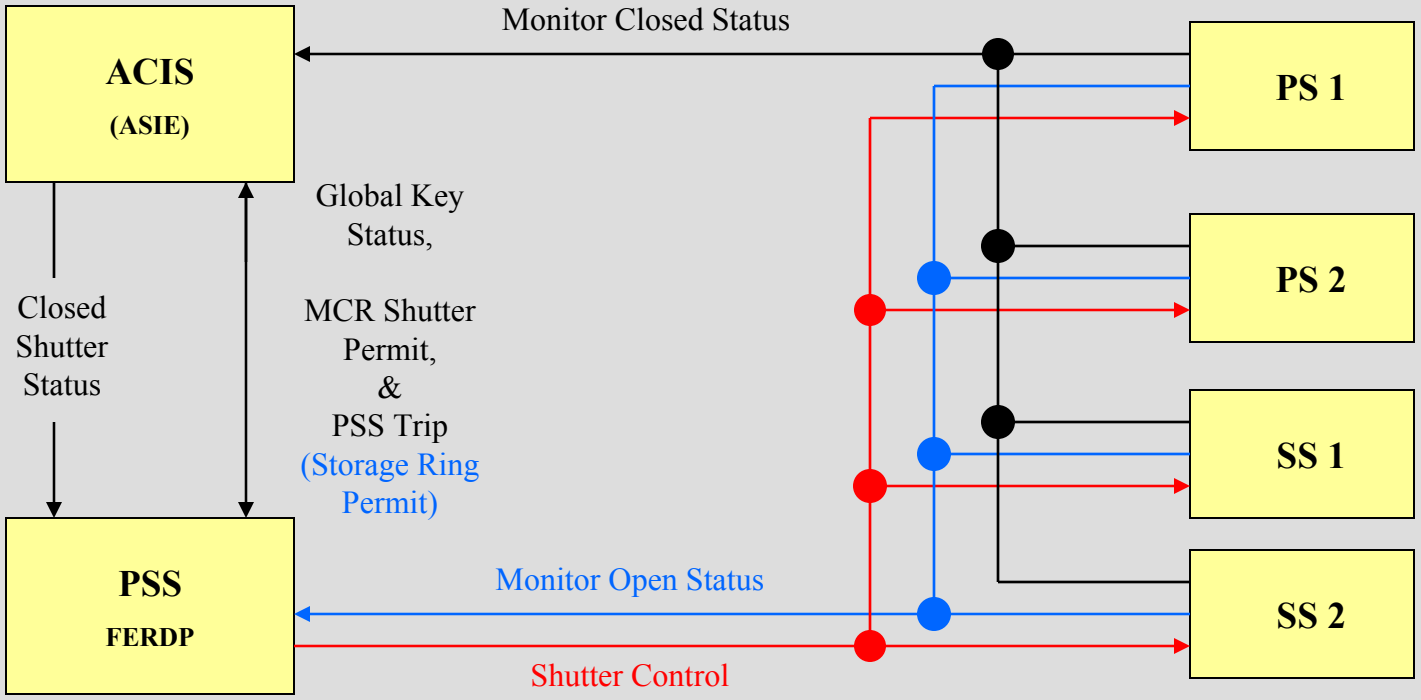


- ACIS monitors the closed positions of all shutters
  - Fans out status to the PSS (Chains A&B)
  - Fans out status to the FEEPS (A only)
  - ACIS uses the summation of PS2, SS1, and SS2. If any are off the closed limit switches the ACIS considers the front end open.
    - No safety credit for PS1
- PSS directly monitors the open position of all shutters

Access Control & Interlock System

ACIS-PSS Interface

Generation 1 Block Diagram



Access Control & Interlock System

ACIS – PSS Front End Interface

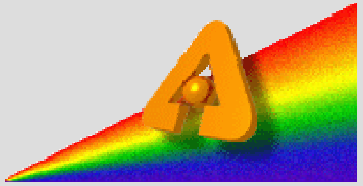
ACIS Logic

Shutter Status (PS2, SS1, or SS2)	Global Key	PSS Trip (Storage Ring Permit)	ACIS Response
All Closed	x	x	OK
All Closed	x	x	OK
All Closed	x	x	OK
All Closed	x	x	OK
Any Open	OFF	x	Trip
Any Open	OFF	x	Trip
Any Open	ON	Tripped	Trip
Any Open	ON	Normal	OK

Access Control & Interlock System

ACIS – PSS Front End Interface

Testing / Validation Requirements, I

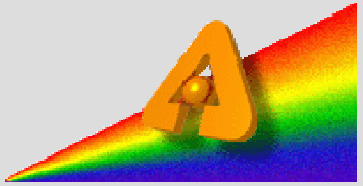


- All active interfaces must be validated during the annual Storage Ring (Sectors 1-34) or RF Area ACIS (Sector 35) validation.
  - Inactive interfaces must have the shutters physically locked down in the tunnel and the air locked off.
- Individual ACIS-PSS interfaces must be validated (subject to extent of affected components)
  - As the final part of a PSS validation after the real shutters are connected if the simulator is used.
  - If the front-end is serviced or modified.
  - If ASIE has been serviced or modified.
- The ACIS logic is validated using built-in fail-safe test switches in the ASIE.
- The ACIS – PSS validation is not to test the ACIS or PSS logic but to demonstrate the physical connections between the systems are functional.

Access Control & Interlock System

ACIS – PSS Front End Interface

Testing / Validation Requirements, II

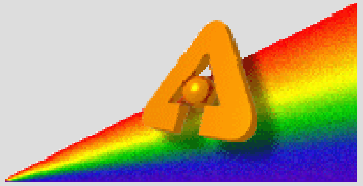


- The validation consists of:
  - Exercising the Shutter Permit from the MCR and verifying its receipt by the PSS.
  - Exercising the Global On/Off Line key switch and verifying its receipt by the PSS. This test also enables / disables the air to the front end shutters.
  - Individually opening PS1, PS2, SS1, and SS2 and verifying:
    - The ACIS and PSS see the shutters come off their closed limit switches.
      - PS2, SS1, and SS2 for the ACIS, summation signal
    - The PSS see the shutters fully open by activation of their open limit switches.
  - Storage Ring Permits are removed in each PSS chain and correctly received by the ACIS (PSS trips).

Access Control & Interlock System

ACIS – PSS Front End Interface

Testing / Validation Requirements, III



- Special Validation Requirements:
  - For a new beam line installations or if shutter wiring has been serviced or modified each chain must be independently tested.
    - The Chain A and Chain B open limit switches are individually activated. Independent open switch confirmations are verified at the PSS.
    - The shutter is opened and the Chain A and Chain B closed limit switches are individually activated. Independent closed switch confirmations are verified at the PSS and the ACIS.

Access Control & Interlock System

ACIS – PSS Front End Interface

Configuration Control

- Each shutter is required to have covers and tamper stickers installed:
  - Prevent unauthorized or inadvertent access to the monitoring switches
    - Backup to the work request system
  - Possible OSHA requirement to prevent injuries from moving parts
  - Before each run the Operations Group checks that the covers are in place as well as the integrity of the tamper stickers.
    - Missing or damaged stickers require independent chain validation tests for that shutter.
    - They hate accesses just before startup.

Access Control & Interlock System

ACIS – PSS Front End Interface
Testing / Validation Problems

- There is no provision in the PSS to individually open shutters.
  - Manual operation of the pneumatic actuators is necessary.
- Communication is a big problem.
  - At best radios are intermittent between personnel on the mezzanine and in the tunnel and/or the MCR.
  - Headphone communication is only available from the ASIE to the MCR.
- The procedure is difficult – prone to error
  - PLC input module led indicators are observed to see if the correct input is massaged. The Leds are small and often other indicators are flashing.
- It is labor intensive (4-5 people):
  - Two persons required at the front end racks (a pusher and a looker)
  - A person in the tunnel to witness the shutter action or activate the limit switches for the independence tests.
  - A yeller (between the mezzanine and tunnel).
  - The ACIS person (on the mezzanine or in the MCR).

Access Control & Interlock System

ACIS – PSS Front End Interface
Testing / Validation Problems

- For newer beam lines:
  - The solenoids are installed in the tunnel. ***Access is no longer optional, it is required for individual operation.***
  - The solenoids for the Photon Shutters are installed backwards (the activating buttons are on the beam side rather side than the ratchet door side requiring the pusher to crawl under the front end.
  - The covers (where installed) have no access holes for the solenoid buttons or the switches. They must be removed to gain access. ***(Mounting screws are on the beam side).***
  - In the spring of 2003 the vacuum group requested a means to individually open each shutter from inside the tunnel without having to use the PSS. ***Requires re-design of the in-tunnel front-end interface.***

Access Control & Interlock System

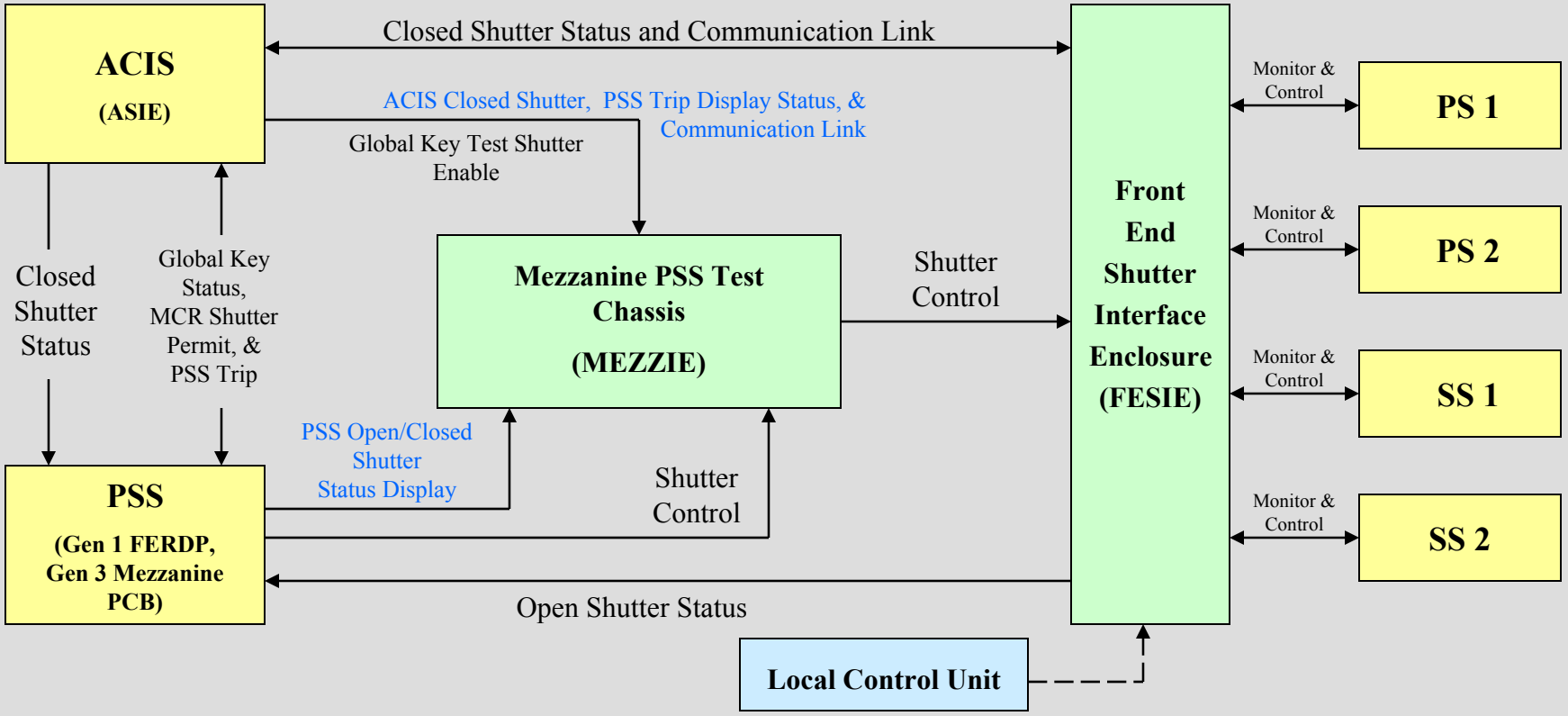
ACIS – PSS Front End Interface

Schedule Problems

- SI personnel are often the last ones in the front end during shutdowns
  - Ad-hoc wiring & conduits to connect monitoring switches and control to the ACIS and PSS.
  - Schedule conflicts with power supply testing and bake outs.
  - ALWAYS schedule pressure to close the ring.

Access Control & Interlock System

Solutions – FESIE and MEZZIE Block Diagram



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Access Control & Interlock System

Solutions I

FESIE

- Front End Shutter Interface Enclosure (FESIE)
  - A collection point to terminate the shutter limit switches, control solenoids, ACIS cables, and PSS cables.
  - A Communication receptacle is installed for headphones between the front end and the mezzanine racks.
  - Receptacles installed to allow local individual control of the shutters using a hand-held box.
    - Designed per the requirements of the vacuum group (latching control circuit, open/closed display leds).
    - Local control is enabled via a key switch installed in the MEZZIE.

Access Control & Interlock System

Solutions II

FESIE

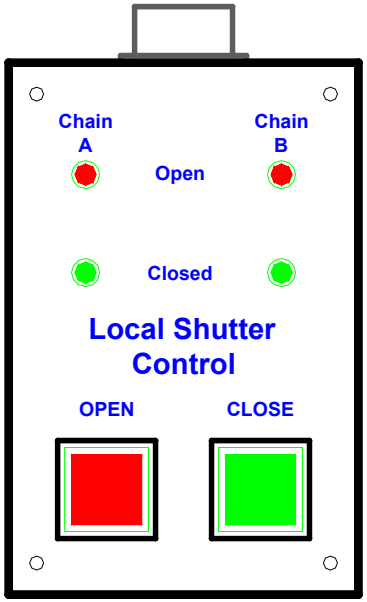
- Front End Shutter Interface Enclosure (FESIE)
  - Reduces schedule pressure.
    - PS2, SS1, and SS2 are installed on a single table. PS1 on a separate table.
    - Tables with all the components can be fabricated with the shutters, FESIE, monitoring switches, and actuators. The switches can be calibrated and all connections tested before the shutdown.
    - Tables are delivered as complete assemblies, only the ACIS and PSS cables need to be terminated.

Access Control & Interlock System

Front End Shutter Interface Enclosure (FESIE)

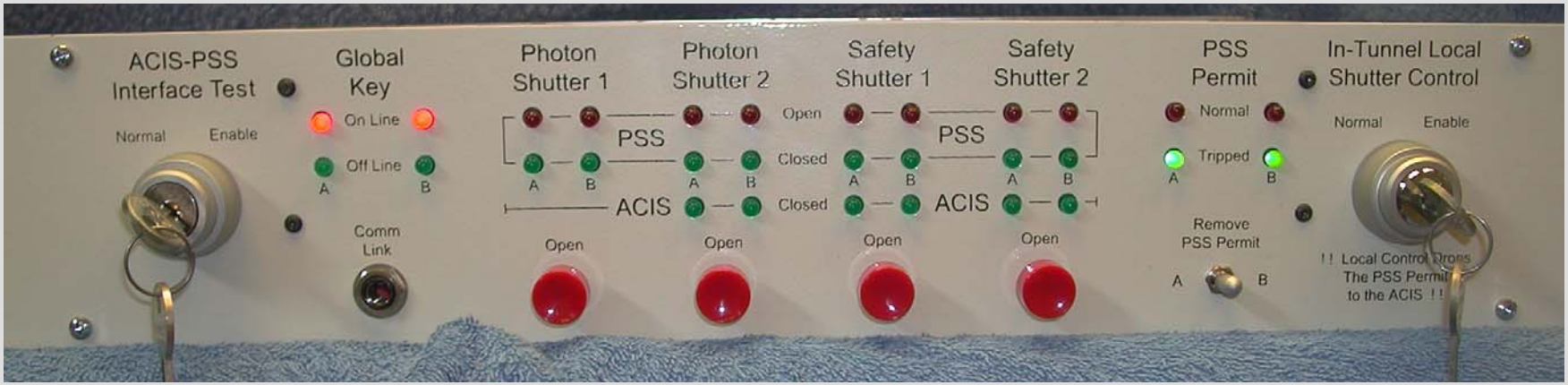
Access Control & Interlock System

Local Shutter Control Unit



Access Control & Interlock System

Mezzanine PSS Test Chassis (MEZZIE)



Access Control & Interlock System

Solutions III

MEZZIE

- Five Functions:
  - Shutter display status driven by the PLCs (always active)
    - PSS open/close status, and in the future, the ACIS close status
    - Eliminates the need to observe I/O module indicators.
  - Contains the key switch to enable local in-tunnel control of the shutters.
  - Permits individual control of the shutters from the mezzanine. (Momentary push buttons)
    - Push buttons are only active if the ACIS-PSS Test key switch is enabled *AND* the Global Key switch is On Line
    - Ultimately the test key will be captured as part of the RF Area ACIS and disable Storage Ring Controlled Equipment (RF Systems and Dipole's Power Supply) when removed.
  - Allows removal of the Storage Ring PSS Permit to the ACIS
    - Only active if the ACIS-PSS Test key switch is enabled
    - Signal passes through the PSS, need not create a major fault, just disable the permit to the ACIS
  - Communication Link to the ASIE

Access Control & Interlock System

Operation

In-Tunnel Shutter Control, I

- The Global Key is set “On Line” to supply air to the shutters.
  - Verified with the MEZZIE’s indicator leds.
- In-Tunnel Local Shutter Control Key is obtained from (???), inserted in the MEZZIE’s key switch and “Enable” is selected.
  - As soon as the key switch is turned, PSS control of the shutters is disabled and any open shutter closes.
  - In Generation 3 systems the Storage Ring Permit is automatically removed through hardware. As the shutters are opened the ACIS will trip to CA Mode.
- The hand held control box is connected to the desired shutter receptacle on the FESIE.
  - Display leds immediately indicate closed status.
- The open button is pressed.
  - Shutter opens and “Open” leds illuminate
- The closed button is pressed.
  - Shutter closes and “Closed” leds illuminate

Access Control & Interlock System

Operation

In-Tunnel Shutter Control, II

- If the control unit is disconnected while the shutter is open, the shutter closes.
- If the control unit is left connected in the tunnel, it is disabled when the key switch on the mezzanine is returned to “Normal”.

Access Control & Interlock System

Operation

Mezzanine Shutter Control I

- The ACIS-PSS Key is removed from the RF Area ACIS.
  - The Storage Ring Controlled Equipment is disabled.
- The key is inserted in the ACIS-PSS Key Switch and turned to "Enable".
  - On Generation 3 systems the Storage Ring Permit is automatically removed by hardware.
  - PSS control of the shutters is removed (any open shutter immediately closes).
  - PSS Chain A and Chain B closure status is indicated by the green leds of each shutter. Red "open" status leds will be off.
  - All ACIS closed leds will be illuminated.
- The Global Key is set to "On Line"
  - Verified with the MEZZIE's leds.

Access Control & Interlock System

Operation

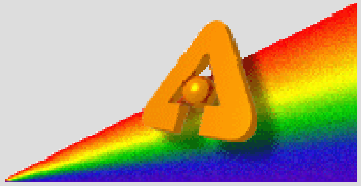
Mezzanine Shutter Control II

- The four momentary active push buttons are now active.
  - Each shutter may be individually opened and will remain open as long as the button is pressed.
  - As each is pressed, the affected shutter will open, the “closed” leds will extinguish and the “open” leds will turn on.
  - All the closed ACIS leds will extinguish (the ACIS only has summary status of the shutters.
- If necessary, chain independence tests may be performed
  - Chain A and Chain B leds will toggle depending on the test.
- When finished:
  - The buttons are released
  - All shutters will indicate closed
  - The key switch is returned to “Normal”
  - If desired, the beam line is taken “Off Line”.

Access Control & Interlock System

Operation

Removal of PSS Storage Ring Permits I



Note: If the following tests are performed with a shutter open, the ACIS will trip to Controlled Access Mode.

- The ACIS-PSS Key is removed from the RF Area ACIS.
  - The Storage Ring Controlled Equipment is disabled.
- The key is inserted in the ACIS-PSS Key Switch and turned to “Enable”.
- Any existing major faults are reset.
  - The red PSS Permit “Normal” leds will illuminate.
- The “Remove PSS Permit” toggle switch is set to the chain to be tested.
  - The PSS logic for that chain will drop its Storage Ring Permit to the ACIS
  - The red “Normal” led will extinguish and the green “Tripped” led will illuminate for that chain.
- The toggle switch is reset to its center position and the PSS reset (if necessary).

Access Control & Interlock System

Operation

Removal of PSS Storage Ring Permits II

- The “Remove PSS Permit” toggle switch is set to the opposite chain.
- The PSS logic for that chain will drop its Storage Ring Permit to the ACIS
  - The red “Normal” led will extinguish and the green “Tripped” led will illuminate for that chain.
- The toggle switch is reset to its center position and the PSS reset (if necessary).
- When finished:
  - The key switch is returned to “Normal” and returned to the RF Area ACIS.
  - If desired, the beam line is taken “Off Line”.

Access Control & Interlock System

FESIE / MEZZIE Changes

- Add pneumatic actuator command leds to MEZZIE driven from the final output in the FESIE to the solenoids for the four shutters.
  - Two recent PS1 problems
- Add Shutter Opened / Closed status and pneumatic actuator command leds to the FESIE for the four shutters shutters.
  - Two recent PS1 problems
- Drive the PSS Permit status leds from the ACIS PLCs
  - All MEZZIE Shutter status and Storage Ring Permits pass through the ACIS or PSS PLCs.
  - Allows three people to perform the entire interface validation
    - One on the mezzanine to operate the Global Key, individually open/close the shutters, and remove the PSS permits
    - One in the tunnel to observe the action of the shutters
    - An MCR operator to exercise the MCR Shutter Permit